FYT Jeans - Ergonomically designed jeans for active and sedentary lifestyles

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OBJECTIVE

Clothes are designed to fit people within a range of dimensions and general body types. Designers rely on anthropometric studies of target populations, considering their standing and static position. Personalized fit can be more readily attained today if desired as body scanners can provide individual dimensions instantly, whilst manual studies with the tried and true measuring tape and emerging anthropometric devices can further improve accuracy.

Yet, the consumer cannot be sure of "best fit" simply by referring to product information. Different brands use different measurements and provide different size numbers, with different steps between sizes. The active person is further at risk for fit changes when we sit to work, drive, or just travel, when we walk, bend, ride a bike or a horse. Our body shape and measurements change with motion, but the clothing we wear is not designed to adapt to the, and what fits in one scenario may not in another, creating in some circumstances not just discomfort but even damage.

In this paper we present the results obtained with the design and engineering of a pair of jeans, able to move with our body, reflecting the way we lead our lives. Because we don't stand up all day, garment design should conform to body position and posture, not just shape and size. Sensors to measure compression forces, pressure and temperature were used while participants were working in a sitting position with their standard jeans and with *FYT Jeans – Engineered for Comfort*. The new jeans provided significant decreases in compression forces, especially in and around the knees, waist and crotch.

INTRODUCTION

21st century people sit for the bulk of the day, at home and at work, and in some jobs, such as the case of call centers, this sedentary behavior can absorb 90% of our working time [1, 2, 3]. Commuting even poses postural changes to our clothes. We sit while driving a car, in a flight, or using the train, bus, or metro and assume more dynamic postures when we commute - but never the same. Bicycling, gentle walking, brisk taking of stairs all impose a range of stresses and most of us cycle through extremes of positions; sedentary or dynamic, our body changes constantly in shape and relative size.

Carvalho et al. [4] performed a comparative anatomical study between the standing and sitting positions, analyzing the dimensional and postural alterations of individuals. They identified the main changes that occur when people sit. These include the increase in volume in the abdominal region; Change in height, volume and inclination of the waist; Increase of the leg frontal length caused by the flexion of the knees. Designing clothes adapted for people propelled while seated in a wheelchair. Pattern design was adapted to fulfill the different body shape and measurements of the modern person – creating the innovative dynamically responsive *FYT Jeans*.

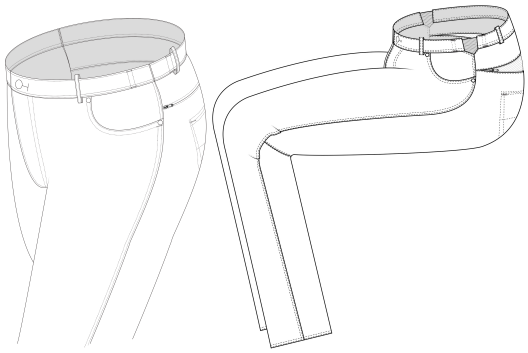

Figure 1 - *FYT Jeans* look standing and sitting.

Jeans represent an icon in the fashion industry, their use has extended far beyond the working wear for which originally invented. We envision their use at all occasions for all ages, genders, and social status. Design innovations provide different fit, from super skinny, slim, regular, relaxed, loose, etc., waist position, etc. Common aspects make jeans recognizable and appealing. Patterns, contrast seams, types of stitches and seams, button's, rivets, labels, pockets are details that make jeans a universal cloth, used by all. Yet, jeans can often be stiff and do not usually mold to positional needs and are even more challenging when walk turns to run and rest to work.

Obtaining the same comfort (in all its variables), in the same pair of jeans was our main challenge. The FYT jeans' design was intended to move with our bodies while commuting or seating down, keeping in mind the ergonomics of position but also respecting the standard look of traditional jeans.

These innovative FYT jeans have the following principle characteristics:

• The knee is bent most of the time, so the excess of material that accumulates on the back of the knee was strategically removed, reducing temperature and compression;

• The waistband grows in accordance with the demand of changing waist dimensions with changes in posture. Hidden elastic positioned in both sides of the waistband allows its circumference to increase according to the constant girth variation of the waist. This engineering of the waistband allows an important reduction in compression forces in the region where the trousers grip the waist;

• Because crotch length varies considerably when sitting, the *FYT Jeans* design and engineering incorporates an invisible zipper in the sacral area (in a traditional jeans seam

– yoke) allowing for the growth of the crotch length (with inner elastic tissue) when the user sits. This allows an important reduction of the compression forces in the genital area by repositioning the trousers waistband, providing higher levels of comfort;

• A fourth optional selection for higher levels of comfort when seated considers limiting the length of back pockets (only possible in the styles with interior pockets in the back). In this case, there is a possibility of total pressure reduction by limiting the back pocket length to the point of contact with the support surface.

METHODOLOGY

Data collection

We examined the comfort and fit of this innovative design in 20 subjects. The participants were limited to people that work in the seated position and regularly wear jeans. Variables related to compression forces, temperature and pressure were analyzed, using appropriate sensors. Compression forces were measured with six *Plux* compression sensors physically connected to a device, which then transmitted recorded data via Bluetooth to a tablet. The same device supported one temperature sensor (NTC thermistor). Pressure was measured using a *Tekscan's ConformatTM #5330*, composed by 1024 piezoresistive sensors. The compression sensors and the temperature sensor were placed with adhesive tape in the interior of the jeans on several body locations.

Tests were performed for all 20 participants at the beginning of the day, to ensure that they all would be able to wear the *FYT Jeans* for a whole working day (~ an 8 hours period). Each measurement was conducted for 15 minutes, for a total of 45 minutes. During these 15-minute measurements the participants were asked to perform their usual tasks, sitting at a desk, in front of their computer. The first measurements were conducted with participants wearing their personal jeans, while the second and third set of measurements were conducted with participants wearing the *FYT Jeans* provided for this study.

At the end of the day, each participant had to return the trousers and complete a short *Likert-type* scale questionnaire designed to evaluate participants' perception of comfort and work performance. Different gradations of comfort and performance were included, including overall perception of physical and thermal comfort, performance at work, range of motion allowed, and the impact of these jeans on self-image.

Data analysis

Three observations were recorded every five minutes for each measurement of compression forces and temperature, for a total of nine records for each participant. The mean and variation between measurements of these three observations was calculated. These comparisons were analyzed in terms of decrease of compression in the various body locations.

Data from the pressure-sensing mat were analyzed with *Tekscan*'s software and with a custom-made *LabView* application.

RESULTS

Users perception of comfort was immediate, especially when the invisible zipper in the buttock is open, allowing the growth of the crotch length. The comfort in the knee area and the pressure release in the waist were also referred as having influence in their sense of comfort. These answers confirmed the registered values by the sensors, having recorded compression forces reductions of 77,39% for the backside of the knee and 65,08% for the front side; 90% reduction in the waist; 55,31% lower compression in the crotch sensor and 50% in the coccyx area.

CONCLUSIONS

Comfort involves several variables that must be considered as a whole while designing products. We spend a large number of hours sitting, commuting and only rarely stand static and yet we fit clothes for the standing position. Our body changes in shape and measurements but the garments we wear remain the same, resulting in discomfort or even pain.

In this paper we compared a new-engineered pair of jeans (*FYT Jeans*) with jeans from different brands, measuring compression forces, temperature and pressure, while they were performing their daily tasks in a sitting position. The *FYT Jeans* design was particularly explored in this paper, as well as the main results achieved in the study.

FYT Jeans created less compression forces, especially in and around the knees, waist and crotch. Pressure in the buttocks was also reduced. Temperature measured in the backside of the knee was reduced increasing thermo-physiological comfort.

KEYWORDS

Clothing comfort; Clothing design; Sitting and active positions; Compression forces.

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